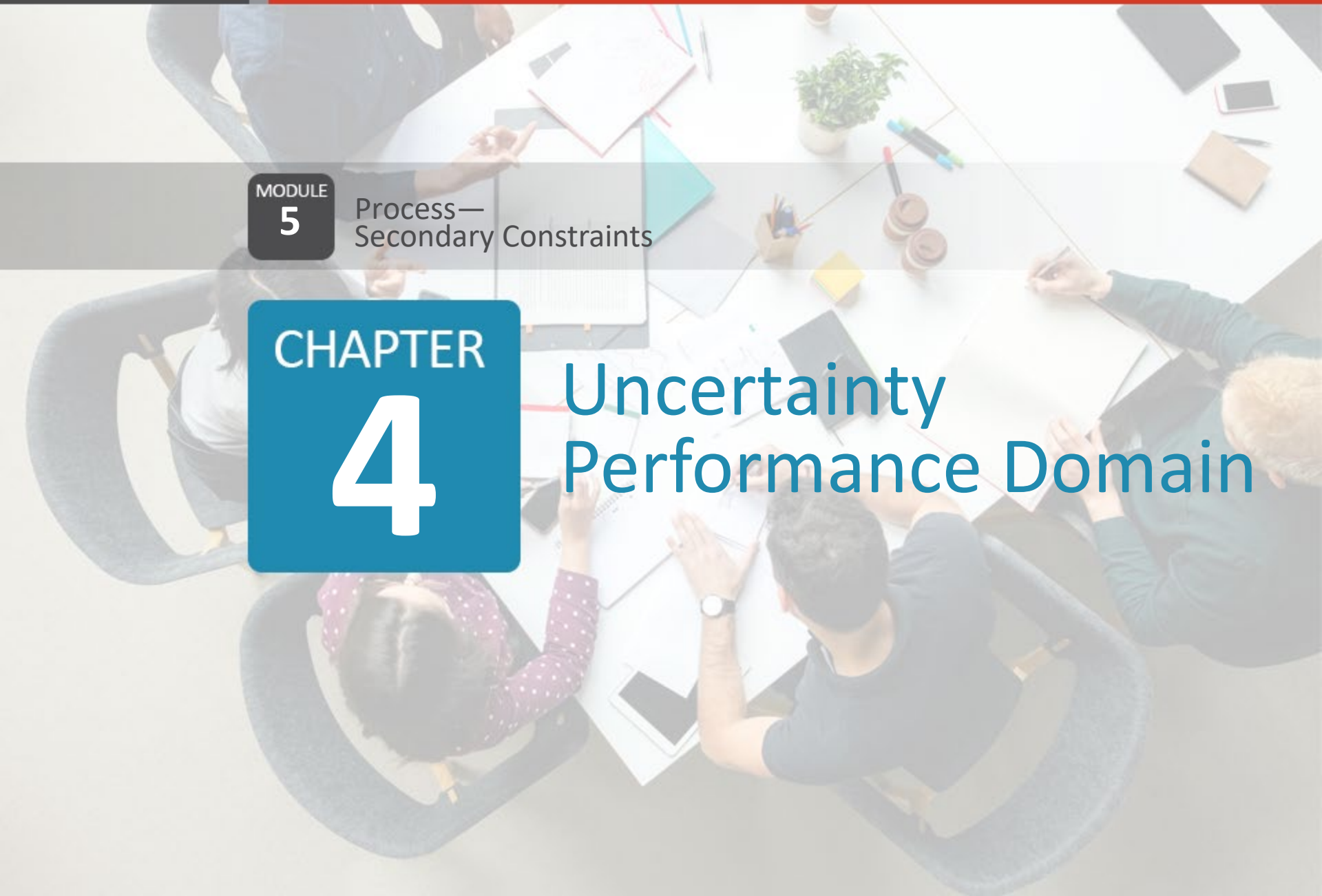

MODULE 5

Process—
Secondary Constraints

CHAPTER 4

Uncertainty Performance Domain

Uncertainty and Risk Concepts

Uncertainty: "A lack of understanding and awareness of issues, events, path to follow, or solutions to pursue."

Risk: "An uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives."

Source: Terminology is quoted from Project Management Institute**,** *A Guide to the Project Management Body of Knowledge* (*PMBOK® Guide*)—*Seventh Edition*, Project Management Institute, Inc., 2021. Material from this publication has been reproduced with the permission of PMI.

About Risks

Opportunity
Risk that would have a positive effect

Threat
Risk that would have a negative effect

Threats or opportunities that are identified =

"Known Unknowns"

Set aside contingency reserves.

Threats or opportunities that have **not** yet been identified =

"Unknown Unknowns"

Set aside management reserves.

Only known risks can be managed!

Uncertainty Roadmap

General uncertainty and risk	• Get informed, make contingency plans, and/or use things like set-based design (SBD) or resilient design.
Conceptual ambiguity	• Standardize terms and revise communications that might be interpreted in more than one way.
Situational ambiguity	• Progressively elaborate, use prototypes, and/or run experiments.
Complex systems	• Decouple subsystems, use simulation and/or scenario analysis.
Reframing of perspectives	• Embrace diversity, get consensus, and/or balance out data sources and methods.
Complex processes	• Use iterative/incremental life cycles, create redundancy/resiliency, and/or engage stakeholders.
Volatility	• Evaluate alternatives, use contingency reserves and/or an agile/hybrid approach.

Terminology

- **Ambiguity.** "A state of being unclear, having difficulty in identifying the cause of events, or having multiple options from which to choose."
- **Complexity.** "A characteristic of a program or project or its environment that is difficult to manage due to human behavior, system behavior, and ambiguity."
- **Volatility.** "The possibility for rapid and unexpected change."

Source: Terminology is quoted from Project Management Institute, *A Guide to the Project Management Body of Knowledge* (*PMBOK® Guide*)—*Seventh Edition*, Project Management Institute, Inc., 2021. Material from this publication has been reproduced with the permission of PMI.

Organization's Risk Attitude

Individual project risk

Uncertain event or condition that has a positive or negative effect on one or more project objectives

Overall project risk

The effect of uncertainty on the project as a whole, arising from all sources of uncertainty, including individual risks

How much overall project risk is the organization willing to accept?

Risk-averse

Risk-seeking

Risk-neutral

Commonly referred to as utility function

Main Facets of Risk Attitude

Risk Appetite	Risk Tolerance	Risk Threshold
Degree of risk the organization is willing to take on	Organization's readiness to bear the risk	Organization's chosen level above or below which a risk should be addressed

Risk attitudes and cultural intelligence:

- Very strong national cultural attitudes toward risk.
- U.S., U.K., Australia, and India tend to be risk-seeking given risk/reward, trust, and relationship building.
- Most other places are risk-averse, e.g., France mitigates with hierarchical authority; Japan uses team-level consensus building.

Tailoring the Uncertainty Performance Domain

- Start with risk attitude.
- Assess risk culture.
- Determine if strategic importance outweighs risk.
- Assess complexity, including external dependencies and interfaces.
- Match risk process to delivery cadence.
- Simplify risk management for projects with low uncertainty, ambiguity, complexity, volatility, and/or strategic importance?

Predictive: Project Risk Management

KNOWLEDGE AREAS	PROCESS GROUPS				
	Initiating	Planning	Executing	Monitoring and Controlling	Closing
Project Risk Management		• Plan Risk Management • Identify Risks • Perform Qualitative Analysis • Perform Quantitative Analysis • Plan Risk Responses	• Implement Risk Responses	• Monitor Risks	

Source: Adapted from Project Management Institute**,** *A Guide to the Project Management Body of Knowledge* (*PMBOK® Guide*)—*Sixth Edition*, Project Management Institute, Inc., 2017, Table 1-4, Page 25. Material from this publication has been reproduced with the permission of PMI.

- Objective of these processes is to **increase** the likelihood and impact of positive events and **decrease** the likelihood and impact of negative events in a project.

Planning Risk Management on Agile/Hybrid Projects

- Agile chosen to mitigate uncertainty risk and demonstrate value in increments.
- Methodology tailored to fit project size.
- Rolling wave planning (requirements, technical uncertainty):
  - Known risk, general risk plans up front.
  - Detailed risk plans and responses per iteration.
- Cross-functional project teams allow knowledge sharing.
- Iteration planning: identification, analysis, planned responses.
- Daily standups: blockers.
- Retrospectives: efficiency and effectiveness of responses.

Predictive: Plan Risk Management

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- Defines ***how*** to conduct risk management activities for a project

Risk Categorization

- Risk categories at program/portfolio level
- Industry-specific risk category lists
- Project objectives
- Root causes
- Cause-and-effect diagram categories
- Internal vs. external risks
- Controllable vs. uncontrollable risks
- Project management vs. technical risks

Risk Breakdown Structure (RBS)

RBS LEVEL 0	RBS LEVEL 1	RBS LEVEL 2
0. ALL SOURCES OF PROJECT RISK	1. TECHNICAL RISK	1.1 Scope definition
		1.2 Requirements definition
		1.3 Estimates, assumptions, and constraints
		1.4 Technical processes
		1.5 Technology
		1.6 Technical interfaces
		Etc.
	2. MANAGEMENT RISK	2.1 Project management
		2.2 Program/portfolio management
		2.3 Operations management
		2.4 Organization
		2.5 Resourcing
		2.6 Communication
		Etc.
	3. COMMERCIAL RISK	3.1 Contractual terms and conditions
		3.2 Internal procurement
		3.3 Suppliers and vendors
		3.4 Subcontracts
		3.5 Client/customer stability
		3.6 Partnerships and joint ventures
		Etc.
	4. EXTERNAL RISK	4.1 Legislation
		4.2 Exchange rates
		4.3 Site/facilities
		4.4 Environmental/weather
		4.5 Competition
		4.6 Regulatory
		Etc.

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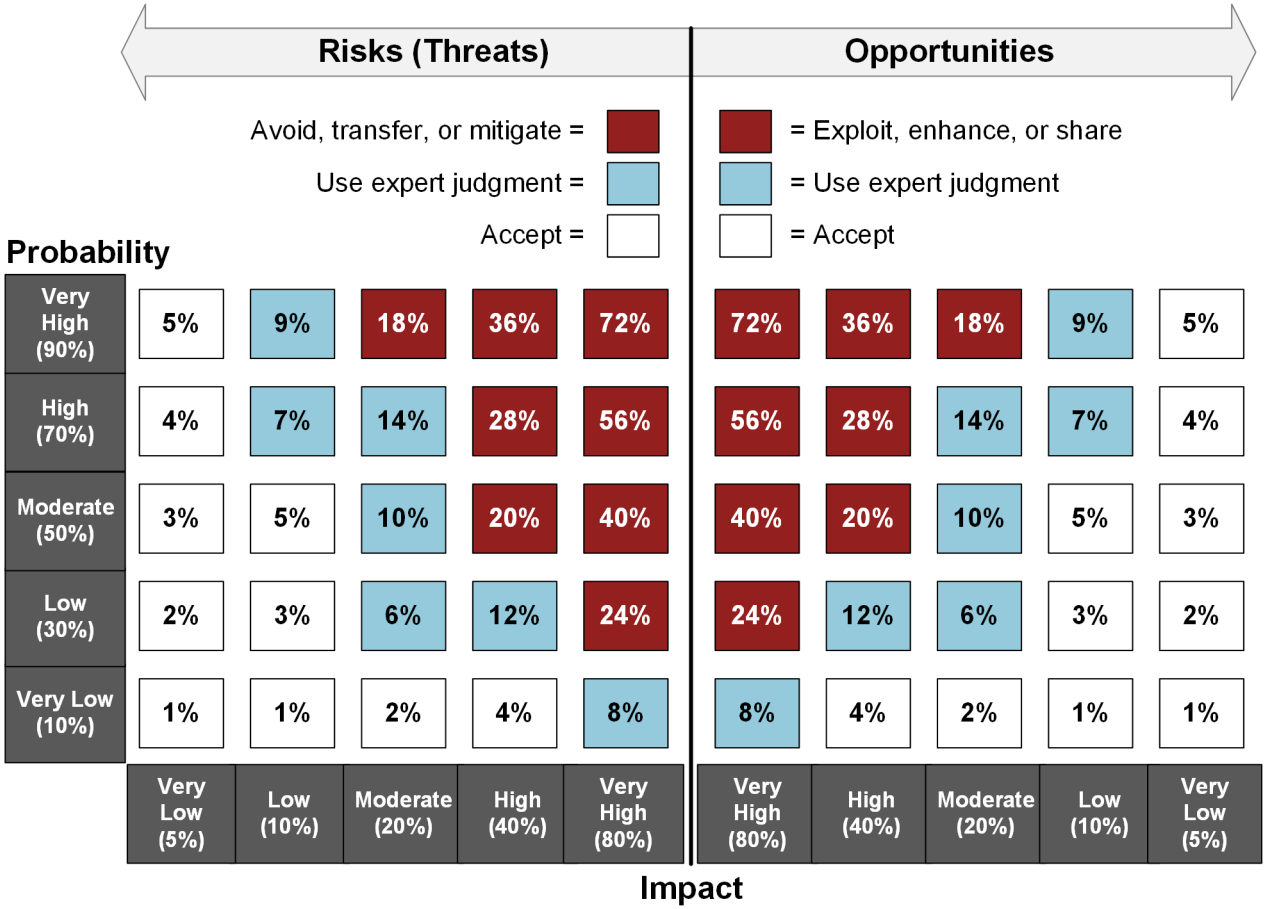
More Risk Terminology

- **Probability:** A percentage estimate of the likelihood that a risk event will occur or an opportunity can be seized or converted.
- **Risk impact:** The degree to which a risk event will affect project objectives if the event occurs.

Probability and Impact Matrix



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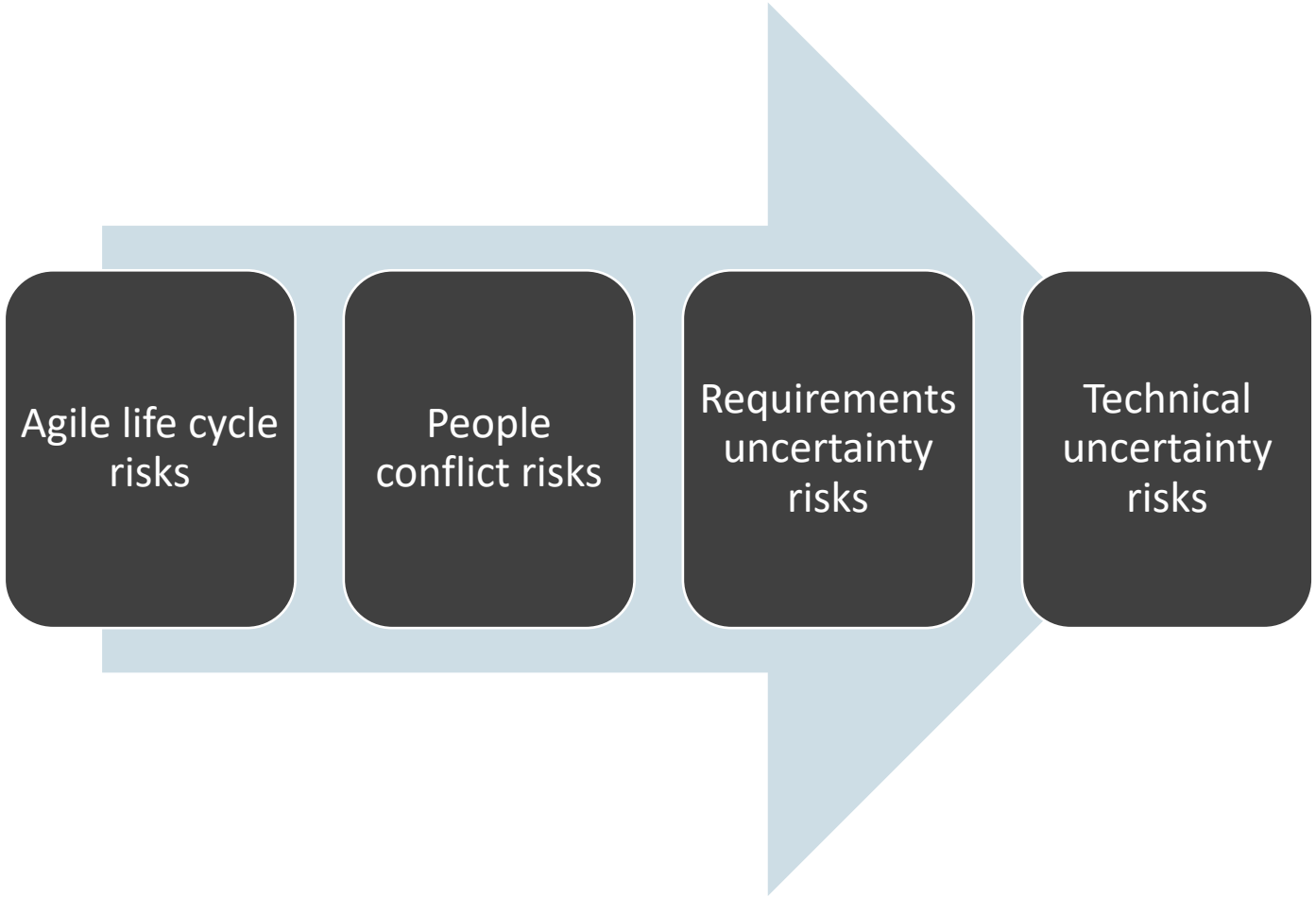
Risk Management Plan

Plan components:

- Risk strategy
- Methodology
- Roles and responsibilities
- Funding
- Timing
- Risk categories
- Stakeholder risk appetite
- Definitions of risk probability and impacts
- Probability and impact matrix
- Reporting and tracking

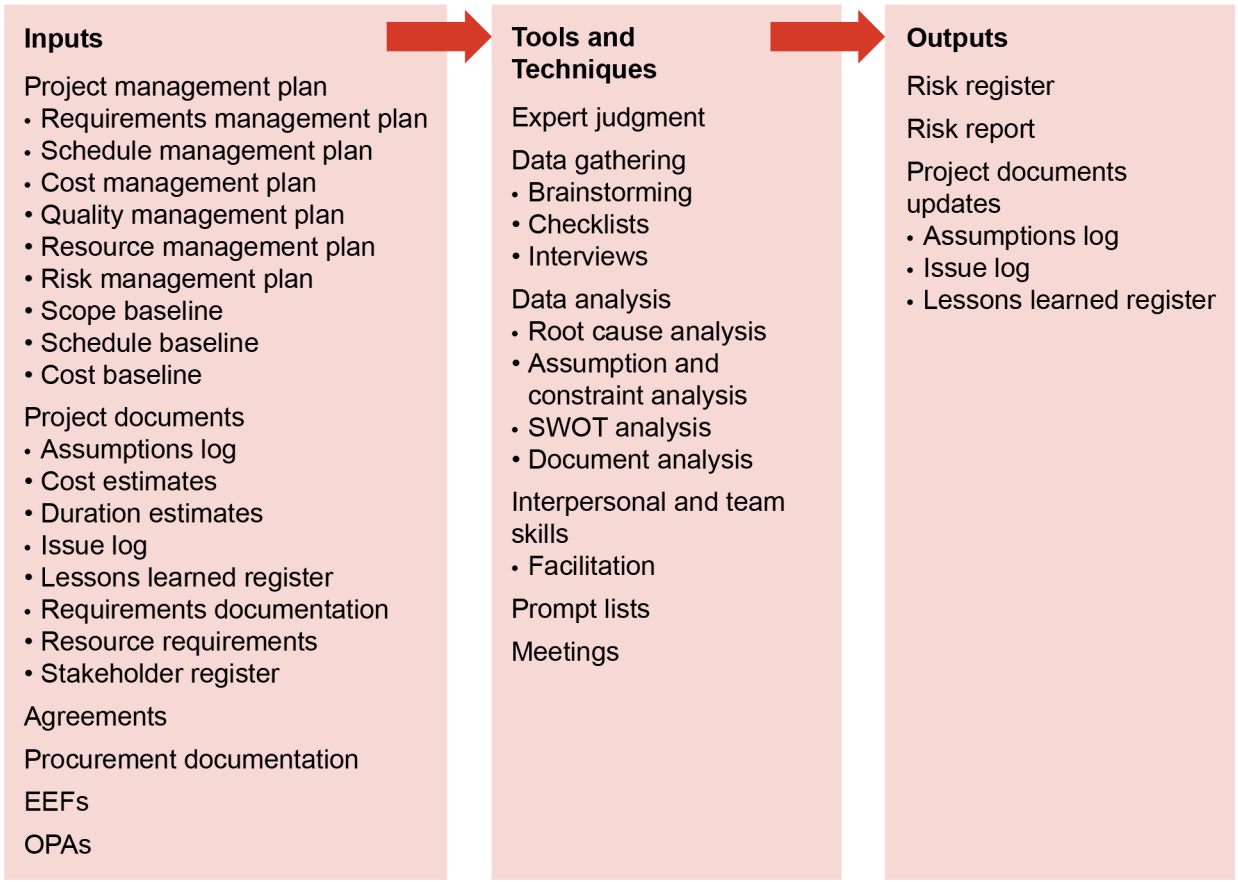
Identifying Risks on Agile/Hybrid Projects



Constant discovery of small risks.

Requirement to provide working deliverables at the end of an iteration means risks are identified quickly before too large.

Predictive: Identify Risks



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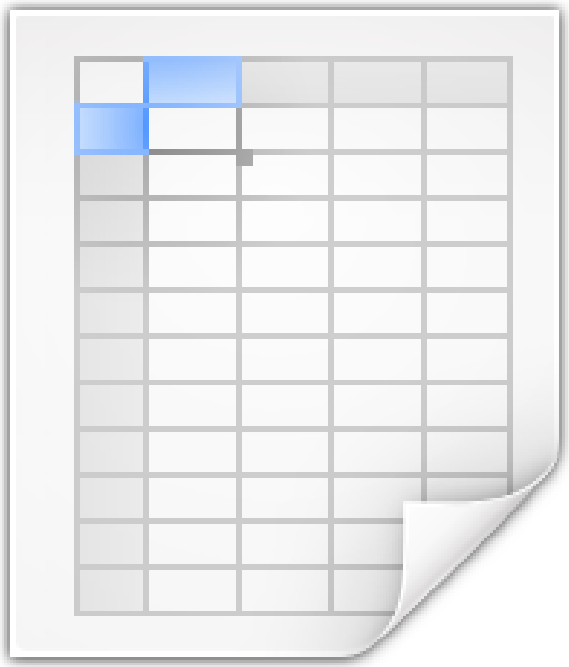
Risk Register



Living document that includes:

- All identified risks.
- Risk analysis ratings.
- Planned responses.
- Responsible person (owner).
- Issues/response outcomes.

Risk Statements

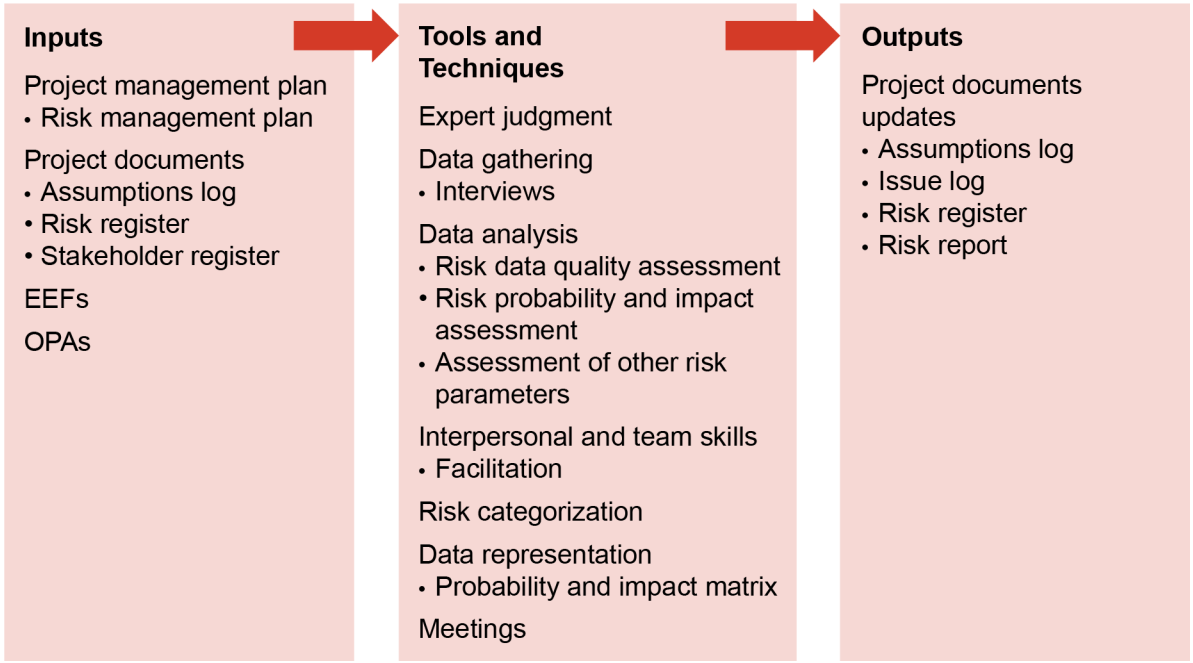
- Describe critical information concerning the cause or source of the risk, the risk event itself, and the effects that will follow if the event occurs.
- Ensure that all risks are clearly and consistently defined.
- Used to identify relations among risks.

Qualitative Risk Analysis

Agile

- Scrum master takes lead as part of role to remove blockers.
- Product owners have big-picture view of risk.

Predictive: Perform Qualitative Analysis



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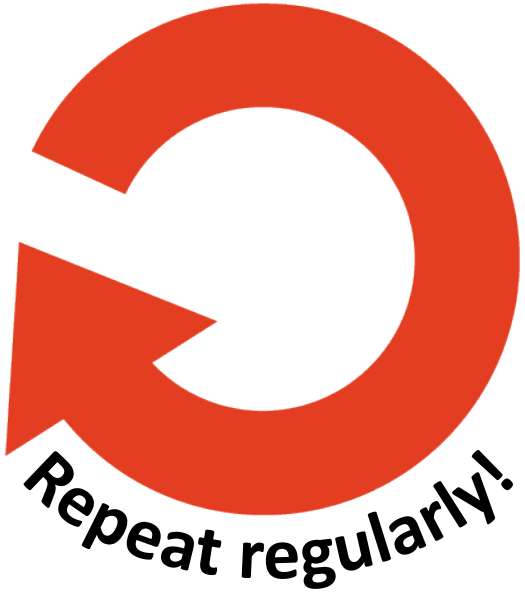
- Prioritizes risks for further analysis or action by assessing the probability of occurrence and impact.

Qualitative Analysis

You have identified your risks…what next?

- Perform subjective analysis to determine each risk's **uncertainty, priority,** and **urgency.**

Qualitative analysis is a fast and cost-effective way to establish risk management priorities.



Project Risk Evaluators

Not all risks are created equal.

- Some are more likely than others.
- Some are more urgent than others.
- Some have a greater impact than others.

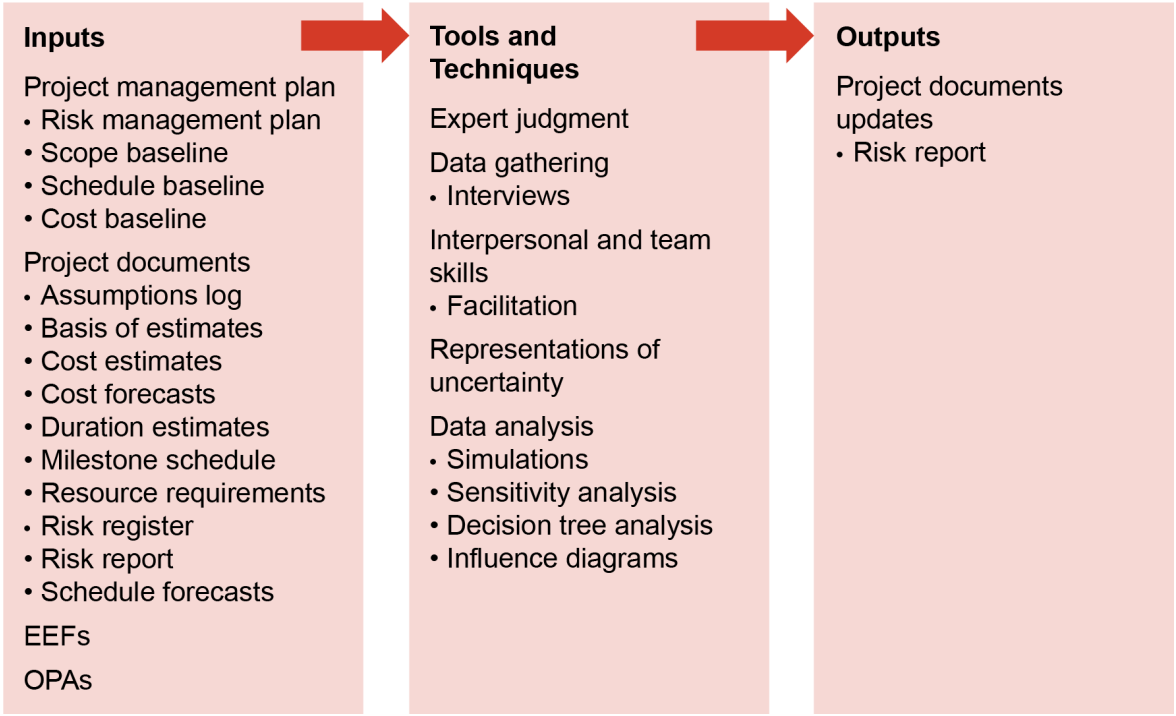
Ranking of
HIGH, MEDIUM, LOW

Quantitative Risk Analysis

Agile

- Performed same as for predictive but may be reserved for upcoming iteration.

Predictive: Perform Quantitative Analysis



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Quantitative Analysis

- Numerical analysis of risks
- Quantified according to their **expected monetary value (EMV)**
- Reduces project uncertainty through better decision making

Ranking of NUMERICAL RATING

Data-Gathering and Representation Techniques

Interviewing

Key technique to gather information on optimistic, most likely, and pessimistic estimates

Simple average

Weighted average

Multipoint Estimates

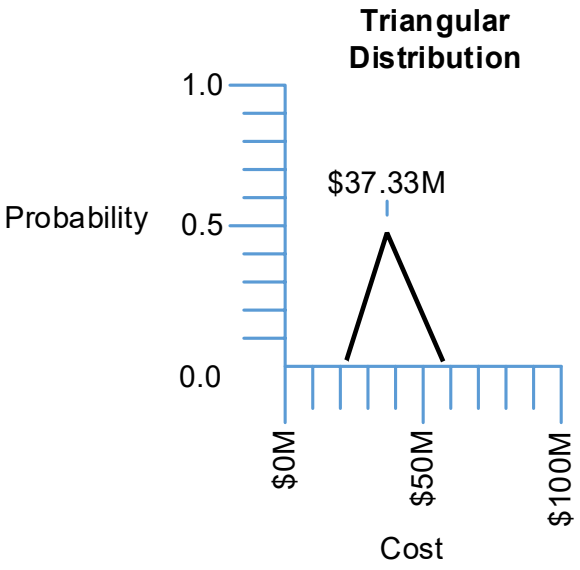
WBS Element	Optimistic (O)	Most Likely (M)	Pessimistic (P)	Triangular $\frac{O + M + P}{3}$	Beta $\frac{O + 4M + P}{6}$
Design	$3M	$5M	$10M	$6M	$5.5M
Construct	$26M	$30M	$38M	$31.33M	$30.67M
Total Project	**$29M**	**$35M**	**$48M**	**$37.33M**	**$36.17M**

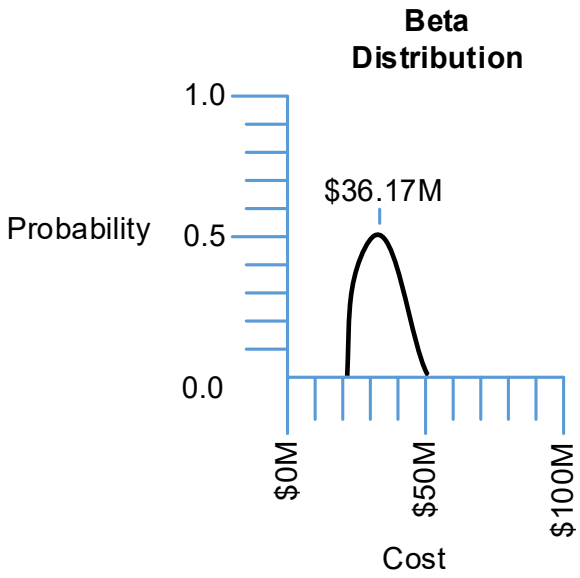
(US$)

Data-Gathering and Representation Techniques

Probability distributions

Graphs of probability on the vertical (y) axis against possible results on the horizontal (x) axis





Quantitative Risk Analysis and Modeling

Expected monetary value (EMV)

Principal method for quantifying risk in a project

EMV = Probability × Impact

Example:

A risk with a 30% chance of occurring that could increase budgeted costs by US$100,000 and a corresponding opportunity with a 70% chance of decreasing budgeted costs by US$400,000.

$EMV_{Risk} = 0.3 \times –US\$100,000 = –US\$30,000$

$EMV_{Opportunity} = 0.7 \times US\$400,000 = US\$280,000$

Net EMV = –US$30,000 + US$280,000 = US$250,000

Quantitative Risk Analysis and Modeling

Decision trees

"Diagramming and calculation technique for evaluating the implications of a chain of multiple options in the presence of uncertainty"

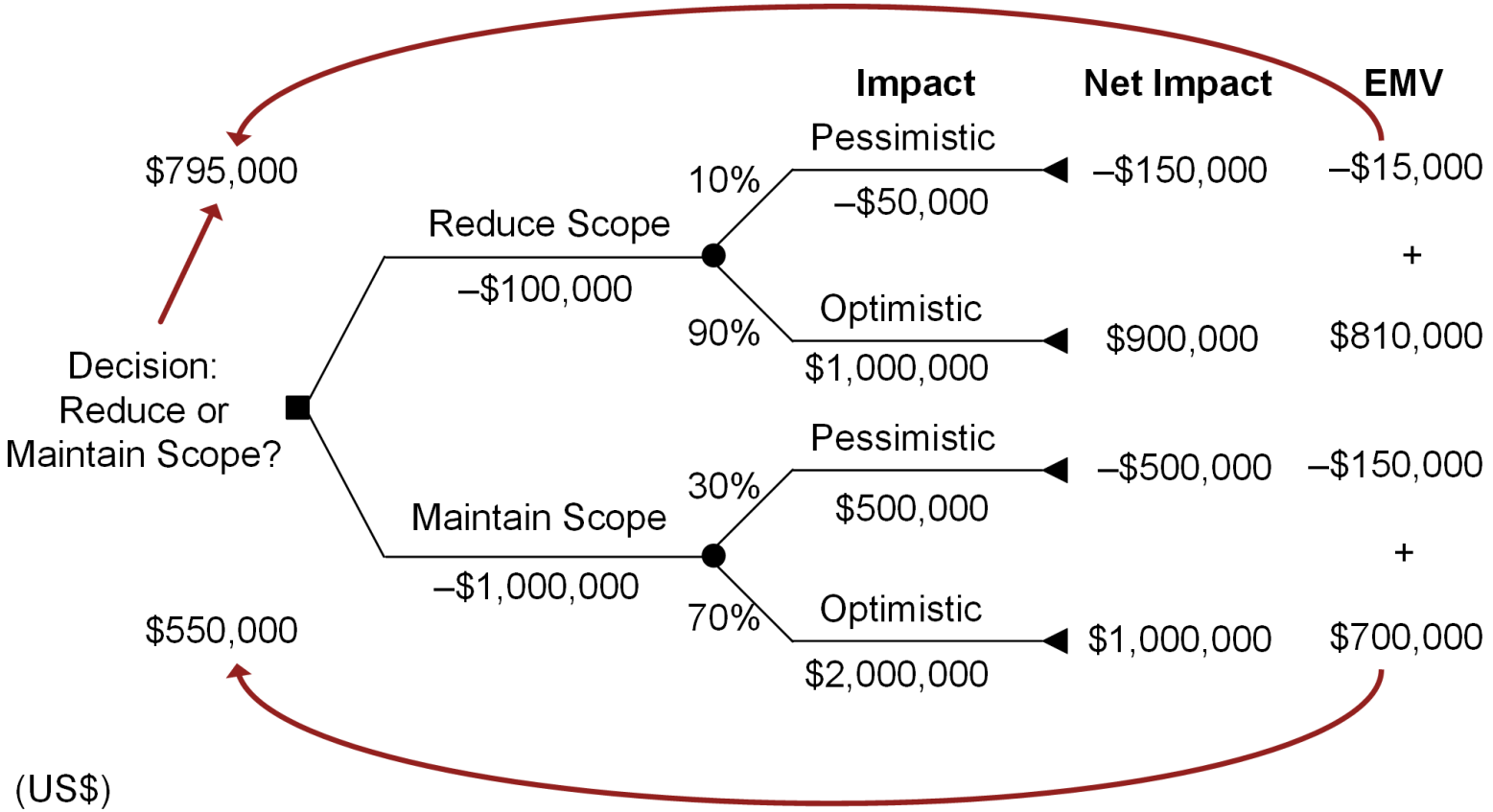
EMV of a Project Decision

Decision	Case	Cost		Impact		Net Impact		Probability		EMV
Reduce Scope	Pessimistic	–$100,000	+	–$50,000	=	–$150,000	×	10%	=	–$15,000
	Optimistic		+	$1,000,000	=	$900,000	×	90%	=	$810,000
Net EMV										$795,000
Maintain Scope	Pessimistic	–$1,000,000	+	$500,000	=	–$500,000	×	30%	=	–$150,000
	Optimistic		+	$2,000,000	=	$1,000,000	×	70%	=	$700,000
Net EMV										$550,000
Decision EMV						**(Highest EMV option)**				**$795,000**

(US$)

Quantitative Risk Analysis and Modeling

Decision tree analysis



Discussion Question

You are managing a facility renovation project. There is an 80% chance that supplier availability will cause a two-day delay costing US$9,000. There is also a 30% chance that the price of building materials will drop, which could save you US$15,000.

What is the project's EMV?

A. –US$7,200
B. –US$2,700
C. US$4,500
D. US$11,700

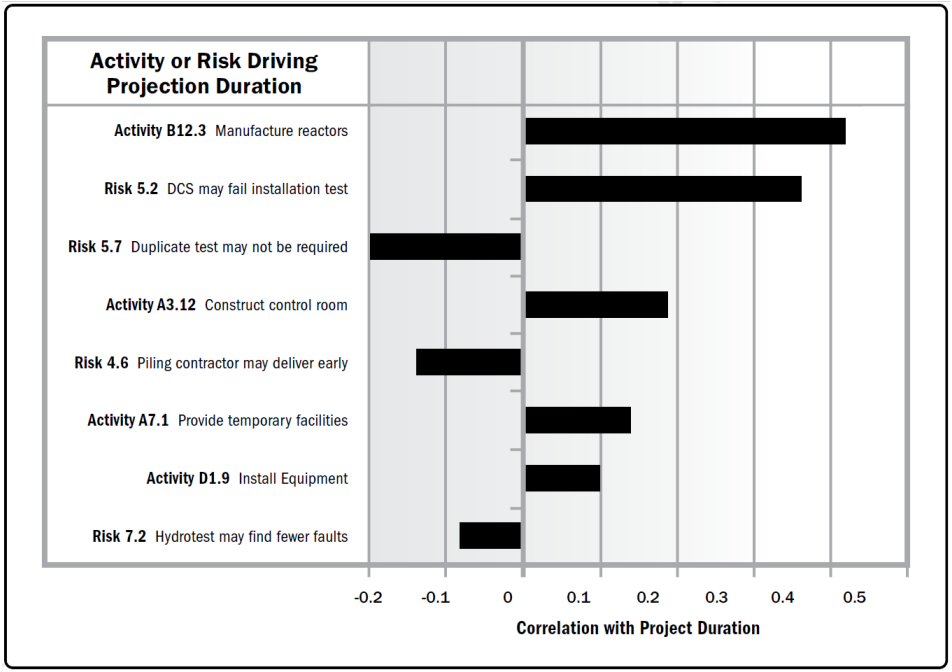
Quantitative Risk Analysis and Modeling

Models: Sensitivity analysis

Type of risk model that changes one variable at a time to isolate its effects.

Illustrates which risks are most impacted by the changes in a selected variable.

Tornado Diagram



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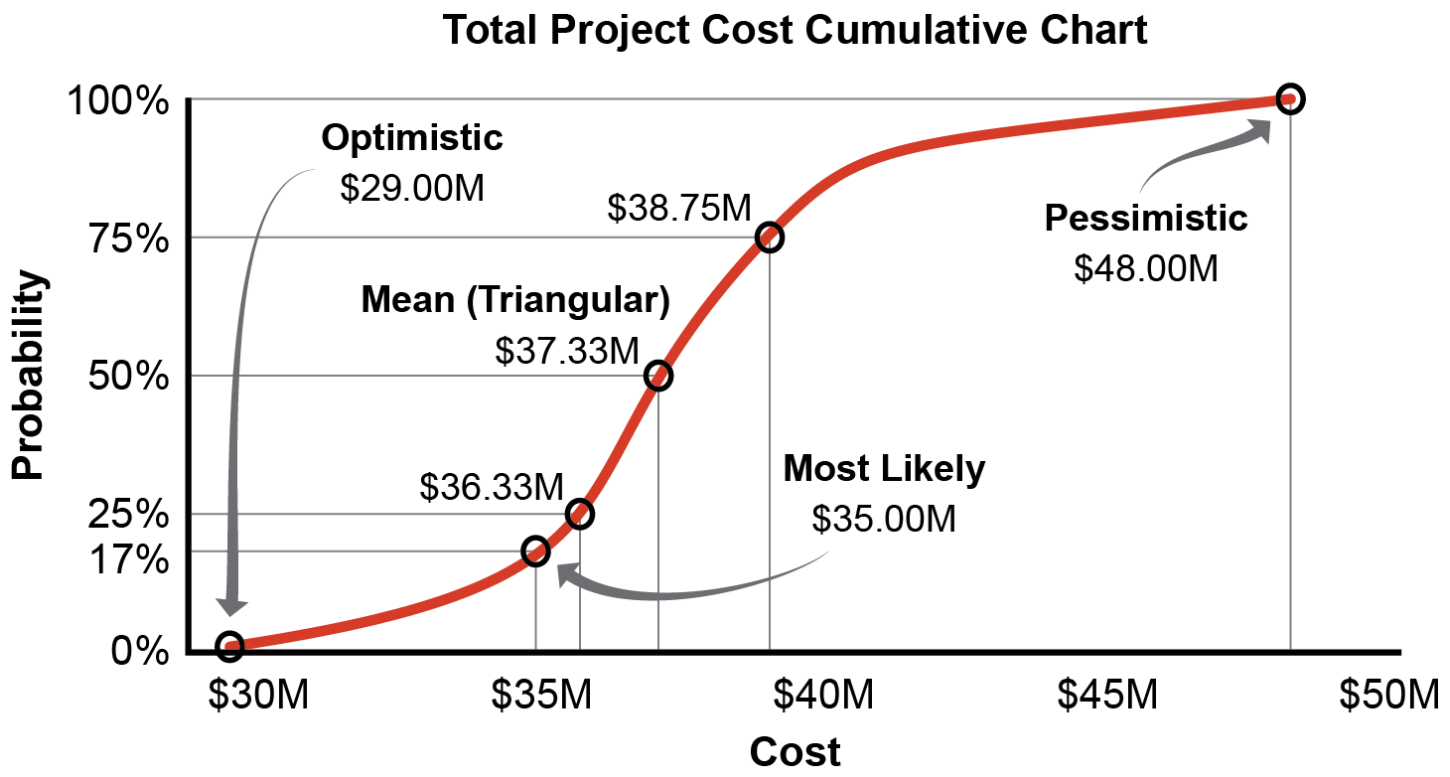
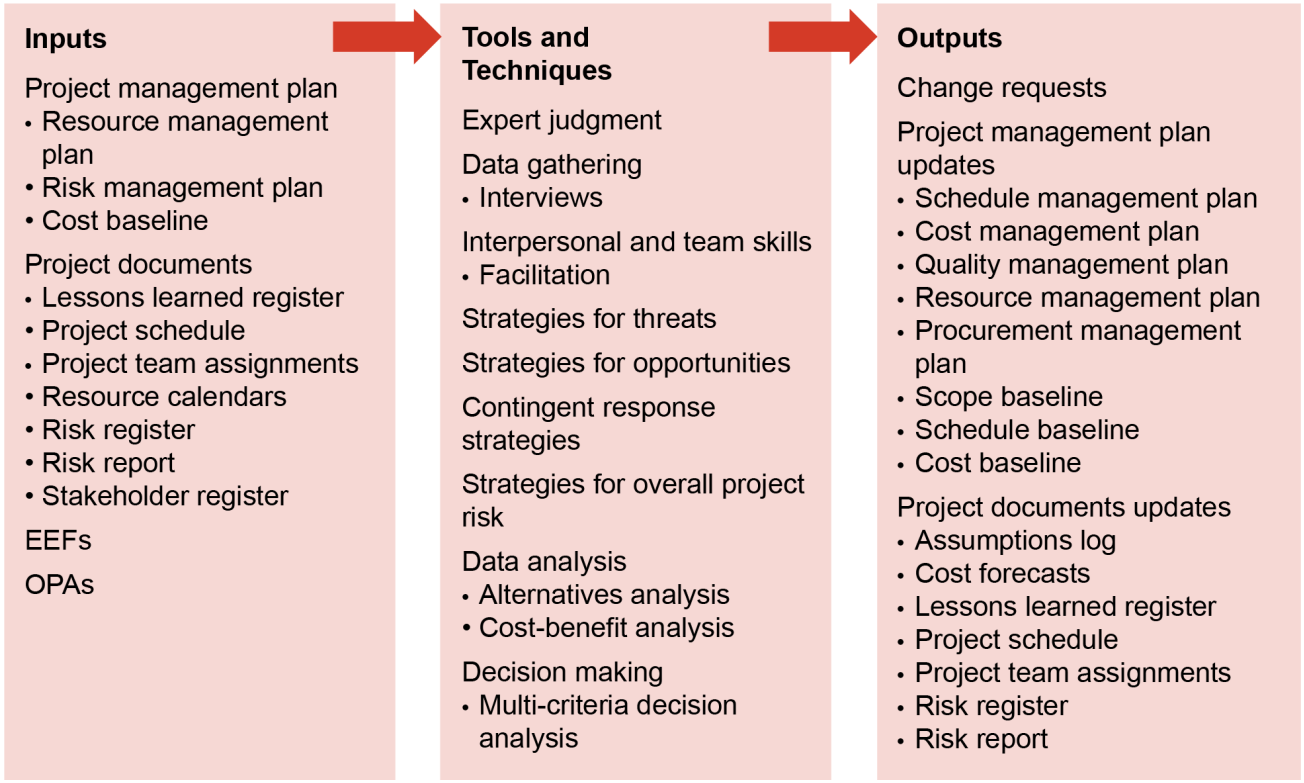
Quantitative Risk Analysis and Modeling

Models: Simulation

Monte Carlo Simulation



Predictive: Plan Risk Responses



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Principle from *Standard for Project Management:* **"Optimize risk responses"** by ensuring that responses are appropriate for risk rating, cost-effective, realistic, agreed upon, and owned.

Risk Responses

Vital components:

- **Agreement and funding:** The risk response needs to be approved and funded.
- **Risk response owner:** One person is accountable for the response.
- **Cost-benefit analysis:** These results indicate that the benefits of enacting the response plan are cost-effective given the nature of the risk and project constraints.
- **Other documented options:** These are alternative responses to fall back on if the primary method becomes unfeasible due to increasing cost, lack of time, etc.

Response Strategies for Threats

Escalate	• Higher-level authority accepts responsibility for risk/response.
Avoid	• Eliminate threat by changing the plan. • Isolate objectives from impact or change an objective in jeopardy.
Transfer	• Third party knowingly accepts some or all of the risk/response. • Usually requires a risk premium (e.g., insurance payments).
Mitigate	• Reduce probability and/or impact to within threshold limits. • Respond early, before issue, for best effect.
Accept	• Acknowledge the risk but do nothing because it has a low risk rating or it has no viable or cost-effective response.

Response Strategies for Opportunities

Escalate	• Ensure that opportunity outside project scope is realized. • Identify higher-level authority and communicate details.
Exploit	• Ensure that opportunity is realized by applying existing resources. • Eliminate uncertainty and go for it.
Share	• Third party adds expertise to ensure that opportunity is realized. • All parties can have net gain, but rewards are shared.
Enhance	• Increase probability and/or impact of opportunity by influencing root causes.
Accept	• Acknowledge opportunity but do not actively pursue because has a low rating or no viable or cost-effective response.

Discussion Question

Which is **not** a valid way to respond to a threat?

A. Avoid
B. Exploit
C. Mitigate
D. Accept

Contingent Response Strategies

- Contingent response: A response plan that is executed only if certain events occur, when there is sufficient warning to implement the plan.
  - Often called contingency or fallback plans.
- "Trigger events" set the plans in effect and release contingency funds.
- Create project resilience to manage emerging risks.
  - *Standard for Project Management* principle: **"Embrace adaptability and resiliency"** rather than sticking to a plan despite waning value.

Risk Response Planning Outputs

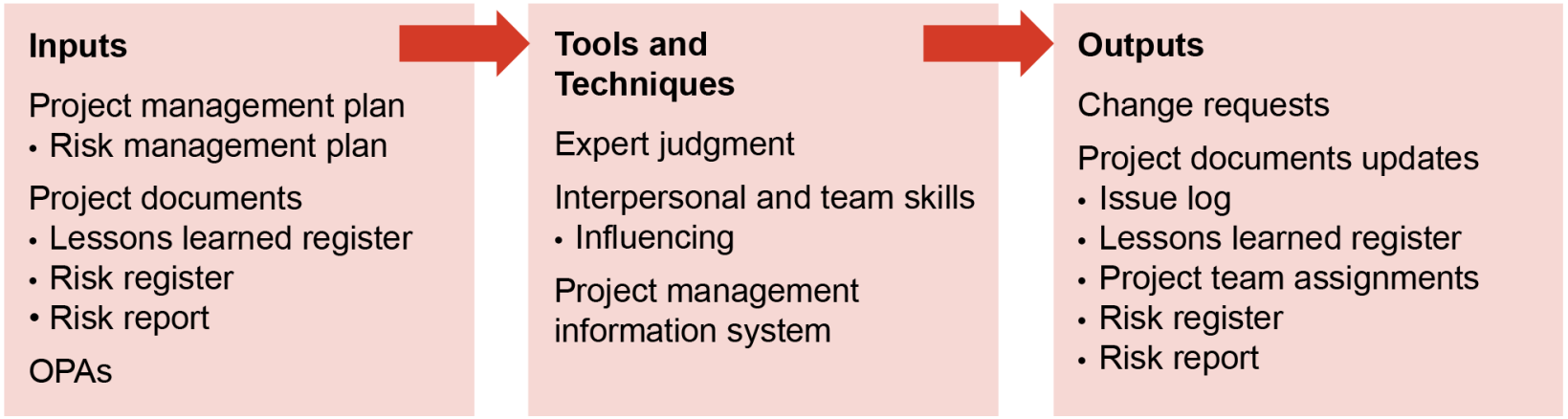
- Change requests
- Project management plan updates
  - Changing baselines
  - Updating schedule, cost, quality, resource, and procurement management plans
- Project documents updates
  - Risk register
    - Trigger events and responses added
    - New risks identified; watch list updated
      - Residual
      - Secondary
  - Risk report
  - Assumptions log updates
  - Cost, schedule, team assignments
  - Lessons learned

Discussion Question

What is used to monitor low-priority risks?

A. Delphi technique
B. Monte Carlo simulation
C. Watch list
D. Probability and impact matrix

Predictive: Implement Risk Responses



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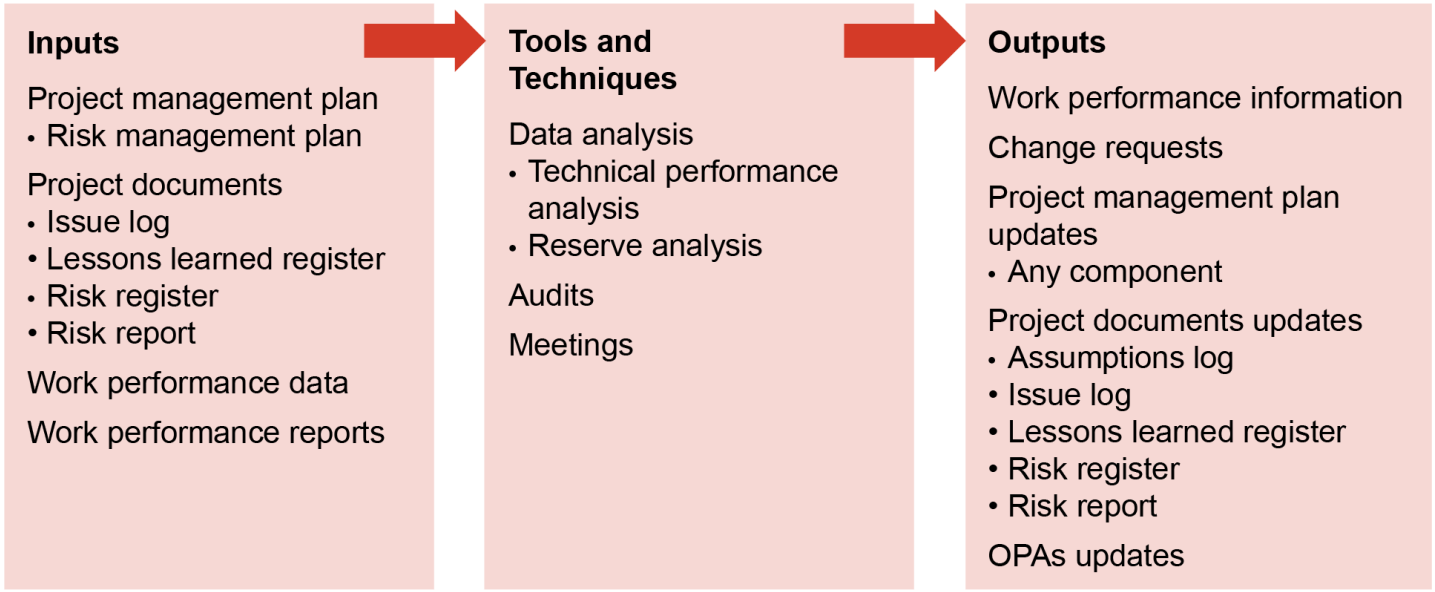
Ensures that:

- Project risk exposure is addressed.
- Specific risk responses are executed as planned.
- Relevant actor or stakeholder executes required action.

Steps to Implement Response

1. Agree upon appropriate risk response.
2. Allocate resources (project manager).
3. Assign appropriate team members (project manager).
4. Execute the response (team members).
5. Submit change requests (if needed).
6. Update as needed:
   - Issue log
   - Lessons learned register
   - Risk register
   - Risk report
   - Project team assignments

Predictive: Monitor Risks



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- Improves efficiency throughout project life cycle to optimize risk responses

Monitor Risks Process

- Are assumptions still valid?
- Have the risks become more or less probable?
- Have the risks become more or less impactful?
- Can any of the risks be retired?
- Are there any new risks to be added?
- Are the risk management policies and procedures being followed?

Reserve Analysis

Amount of contingency reserves remaining

VS.

Outstanding risks and their expected monetary values

Comparison

If inadequate = change request.

Meetings

Project risk management should be a regular agenda item at project status meetings.

Status of risks and responses reviewed and updated for relevance and priority level.

Outputs

- Workarounds
  - Unplanned corrective actions.
  - Address unknown risks.
  - Impromptu response.
- Retiring risks
  - For risks no longer relevant to the project.
  - Expired risks.
  - Related to events that have come to pass.